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(54) IMPROVEMENTS IN OR RELATING TO STEPLESSLY VARIABLE FRICTION TRANSMISSION GEARS

(71) We, ALLSPEEDS LIMITED of Royal Work, Clayton-le-Moores, Accrington, Lancashire, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a steplessly variable friction transmission gear.

In Patent Specification 618 774, a transmission gear of this type is described in which driving and driven shafts each carry a wheel having a rim flange. The rim flanges of the two wheels engage with the surfaces of a plurality of substantially spherical roller bodies arranged between the two wheels and equidistantly about the wheels. A mechanism is provided for tilting the axes of all the bodies together, to effect a change of speed between the driving and driven shafts.

The object of the present invention is to provide a steplessly variable friction transmission gear which is simpler and cheaper to manufacture than the transmission gear disclosed in Specification 618 774.

The present invention accordingly provides a steplessly variable friction transmission gear comprising driving and driven shafts each carrying a wheel having a rim flange, a plurality of spherical roller bodies mounted in such a manner that the surface of each body engages with both the flanges, and means for tilting the axis of at least one of the roller bodies for this body to function as a control body, at least one other of the roller bodies being freely mounted.

By requiring the axes of less than all the roller bodies to be tilted to obtain a change in speed ratio, the arrangements for supporting the bodies and for selectively adjusting the angle of tilt can be simplified. Thus the control body can be slidably mounted on a spindle arranged to be tilted by axial movement of a control rod acting on one end of the spindle.

Mounting means for the roller bodies can have the form of a disc having a U-shaped recess for the control body, an aperture for the or each other body, and guide means for the free end of the spindle and for the control rod.

The drive capacity of the gear can be obtained by thrust bearings, conveniently in the form of spaced spring-urged rings, acting on the roller bodies.

By way of illustration, a transmission gear embodying the present invention is described below with reference to the accompanying drawings. In the drawings:

Figure 1 is a sectional side view on the axis of the transmission gear;

Figure 2 is a view along the axis of a ball mounting means included in the gear of Figure 1; and

Figure 3 is a plan view of the ball mounting means of Figure 2.

As shown in Figure 1, the illustrated transmission gear has axially aligned driving and driven shafts 10 and 11 journalled in respective parts of a housing 20. The shafts 10, 11 have adjacent ends at which are secured respective wheel 12 and 13 the wheels having respective rim flanges 14 and 15. Three roller bodies in the form of balls of which only two, indicated by reference numerals 16 and 17, are visible in Figure 1 are mounted so as to engage with these wheel flanges. The balls are equi-angularly spaced about the common axis of the shafts 10, 11. It will be understood that rotation of the driving shaft 10 will be transmitted to the driven shaft 11 by frictional engagement of the balls with the rim flanges 14, 15.

In accordance with the invention, the ball 16 is mounted for rotation about an

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axis which can be tilted so as to vary the speed ratio between the wheels 12, 13. Thus the ball 16 hereinafter described as the control ball is mounted on a spindle 18 in the mounting means for the balls, the other balls being held loosely, for free rotation. As shown in Figure 1, the ball 16 has a diametral bore through which the spindle 18 extends, the spindle being capable of axial movement in the bore.

It will be understood that a 1:1 ratio is obtained in operation with the axis of the spindle 18 parallel to the common axis of the shafts 10, 11. Tilting of the axis of the spindle 18 to the position shown in Figure 1 increases the speed ratio whereas tilting of the axis in the opposite direction from the parallel position decreases the speed ratio. Although control of the gear ratio is effected by tilting of the axis of the control ball 16 only, it is found that as the speed of rotation of the control ball is varied by tilting its axis this variation is also taken up by the other balls. It will, of course, be understood that the load will be shared equally by all the balls.

According to an advantageous feature, the tilting of the axis of the control ball is effected by longitudinal movement of a control element. In the illustrated device, the control element is a rod 19 which is guided in the housing 20 for longitudinal movement radially of the common axis of the shafts 10, 11. The control rod 19 is provided with an aperture 21 at its inner end which is internally part spherical and in which nests a part spherical element 22 provided at one end of the spindle 18 to form a ball joint. The outer end of the rod 19 extends outwardly of the housing 20 for operation to alter the angle of tilt of the axis of the control ball 16.

The drive capacity of the illustrated transmission gear is attained by the provision of two retaining rings 23 and 24 which are acted upon by helical coil springs 25 and 26. The retaining rings 23 and 24 function as thrust bearings. Other forms of spring means for example belleville disc springs may be used and the drive capacity can instead be obtained by other means for example hydraulic or pneumatic means. The thrust bearings may also be of different form for example needle, ball or plain bearings.

Reference will now be made to Figures 2 and 3 which show the mounting means for the balls. The mounting means comprises a spider 27, shown also in Fig. 1, having a U-shaped recess 28 for the reception of the control ball 16. The spider 27 is also provided with apertures 29 for the reception of the other two balls 17. Integral with or secured to the spider 27 are two U-shaped members 30 and 31, the adjacent ends of which form guides for the plain end of the spindle 18 and the control rod 19. It is to be noted that the U-shaped recess 28 and the apertures 29 are all lined with anti-friction material and the same applies to the aperture 21 in the control rod 19.

It will be understood that the invention is not limited to the use of the spider shown and an arrangement of ball bearings could be used to ensure correct spacing of the balls.

The invention can be embodied in forms of transmission gear different from that illustrated. For example, the number of balls may be different. Thus six balls angularly spaced by 60° may be employed. Whatever the number of balls, at least one will be a control ball and at least one will be freely rotatable, the number of control balls being substantially less than the total. Moreover, different mechanisms for tilting the spindle of the or each control ball can be employed. Where a longitudinally movable control roll is used for instance, a simple micrometer arrangement may be employed, the control rod being the spindle of the micrometer. Alternatively, the control rod may be threaded and work in a threaded bore in which case a sprocket drive or a simple control handle may be provided.

WHAT WE CLAIM IS:—

1. A steplessly variable friction transmission gear comprising driving and driven shafts each carrying a wheel having a rim flange, a plurality of spherical roller bodies mounted in such a manner that the surface of each body engages with both the flanges, and means for tilting the axis of at least one of the roller bodies for this body to function as a control body, at least one other of the roller bodies being freely mounted.

2. A transmission gear as claimed in claim 1 in which the control body is slidably mounted on a spindle arranged to be tilted by the axial movement of a control rod acting on one end of the spindle.

3. A transmission gear as claimed in claim 2 having a ball and socket connection between the control rod and the spindle.

4. A transmission gear as claimed in claim 2 or 3 having mounting means for the roller bodies in the form of a disc having a U-shaped recess for the control body, an aperture for the or each other body, and, guide means for the free end of the spindle and for the control rod.

5. A transmission gear as claimed in claim 1, 2, 3 or 4 in which the drive capacity of the gear is obtained by thrust bearings acting on the roller bodies.

6. A transmission gear as claimed in claim 5 in which the thrust bearings comprise two spaced rings acted on by spring means to engage the roller bodies on opposite sides of an equally spaced from a plane through the centres of the bodies.

7. A transmission gear as claimed in claim 6 in which the spring means comprise helical coil springs.

8. A steplessly variable friction transmission gear substantially as herein described wth reference to the accompanying drawings.

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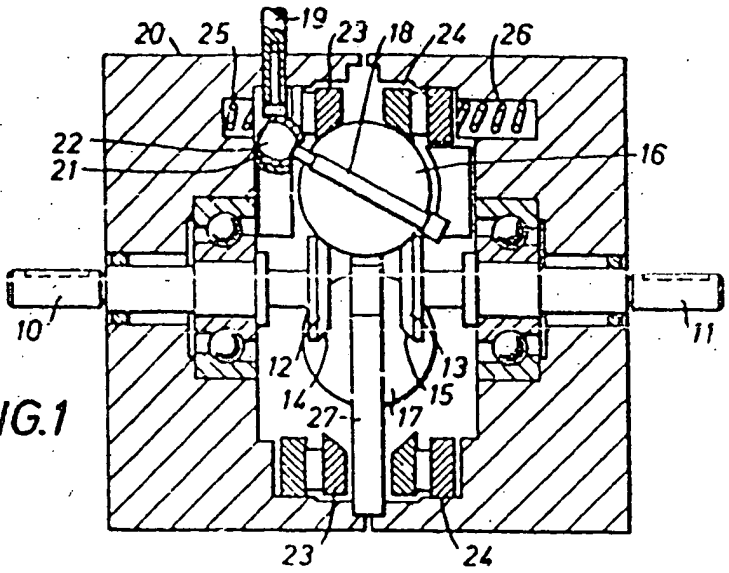

FIG.1

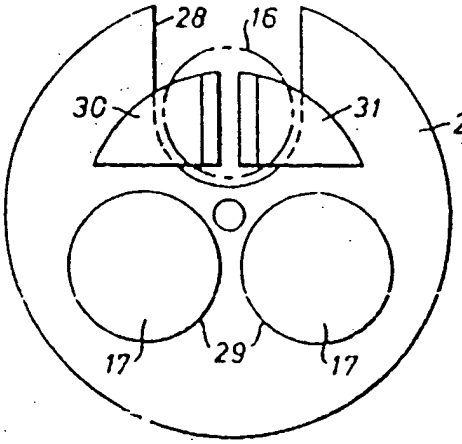

FIG.2

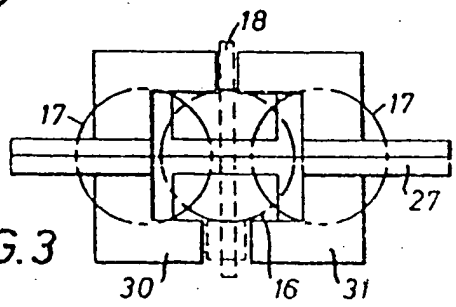

FIG.3